

## Swift Observation of GRB 120701A

*T. N. Ukwatta (MSU), S. D. Barthelmy (GSFC), P.A. Evans (U. Leicester), A. A. Breeveld (MSSL-UCL), D. N. Burrows (PSU), M. H. Siegel (PSU), and N. Gehrels (GSFC) for the Swift Team*

### 1 Introduction

BAT triggered (Trigger 525477) on GRB 120701A at 07:50:41.57 UT. There was no initial set of GCN Notices nor a rapid-response circular because of the power outage at GSFC when this burst occurred. Swift slewed to the burst  $\sim 10$  seconds after the trigger. This was a  $8.78\sigma$  image-trigger on a burst with  $T_{90} = 13.8 \pm 0.7$  sec. The XRT began observing the field 61 seconds after the BAT trigger. XRT found a fading, uncatalogued X-ray source. Our best position is the enhanced XRT location at  $RA(J2000) = 80.34740$  deg (05h 21m 23.38s),  $Dec(J2000) = -58.54973$  deg ( $-58^{\circ}32'59.0''$ ) with an uncertainty of 1.8 arcsec (90% confidence), reported by Evans et al. (2012). The UVOT started settled observations at  $\sim T + 89$  sec and detected a faint optical afterglow consistent with the XRT position.

### 2 BAT Observation and Analysis

Using the data set from  $T - 61$  to  $T + 242$  sec, post analysis of BAT GRB 110402A has been performed by BAT team (Barthelmy et al., 2012). The BAT ground-calculated position is  $RA(J2000) = 80.338$  deg (05h 21m 21.0s),  $Dec(J2000) = -58.531$  deg ( $-58^{\circ}31'52.3''$ )  $\pm 1.3$  arcmin, (radius, systematic and statistical, 90% containment). The partial coding was 60% (the bore sight angle was  $32.7$  deg).

The mask-weighted light curve (Fig. 1) shows shows several overlapping peaks starting at  $\sim T - 2$  sec and ending at  $\sim T - 20$  sec.  $T_{90}$  (15-350 keV) is  $13.8 \pm 0.7$  sec (estimated error including systematics).

The time-averaged spectrum from  $T - 0.0$  to  $T + 15.4$  sec is best fit by a simple power-law model. The power law index of the time-averaged spectrum is  $1.05 \pm 0.10$ . The fluence in the 15-150 keV band is  $1.4 \pm 0.1 \times 10^{-6}$  erg/cm<sup>2</sup>. The 1-sec peak photon flux measured from  $T + 10.36$  sec in the 15-150 keV band is  $1.6 \pm 0.2$  ph/cm<sup>2</sup>/sec. All the quoted errors are at the 90% confidence level.

The results of the batgrbproduct analysis are available at [http://gcn.gsfc.nasa.gov/notices\\_s/525477/BA/](http://gcn.gsfc.nasa.gov/notices_s/525477/BA/)

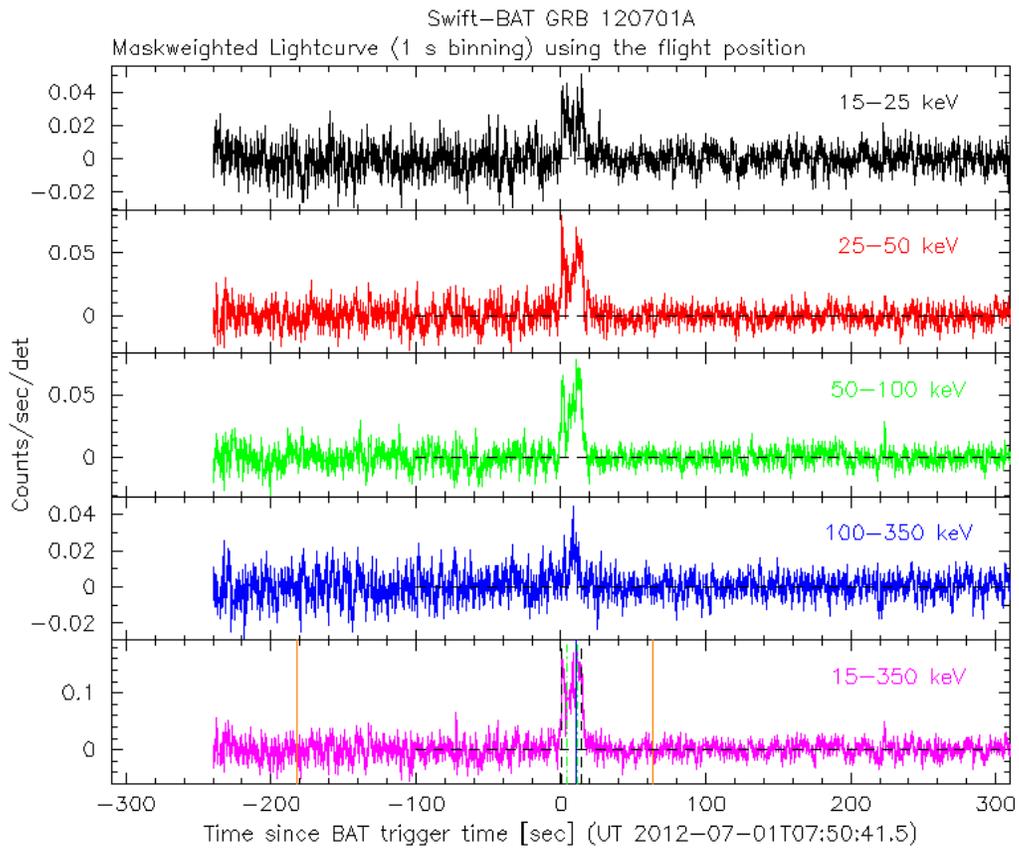


Figure 1: The mask-weighted light curve in the 4 individual plus total energy bands. The units are counts/sec/illuminated-detector and  $T_0$  is 07:50:41.57 UT.

### 3 XRT Observations and Analysis

XRT data were collected from  $T + 61$  s to  $T + 58.8$  ks. The data comprise 69 s in Windowed Timing (WT) mode (the first 9 s were taken while Swift was slewing) with the remainder in Photon Counting (PC) mode. We find an uncatatalogued, fading X-ray source inside the BAT error circle. Using 7344 s of PC mode data and 5 UVOT images, we find an enhanced XRT position (using the XRT-UVOT alignment and matching UVOT field sources to the USNO-B1 catalogue): RA, Dec = 80.34740, -58.54973 which is equivalent to:

RA (J2000) = 05h 21m 23.38s

Dec(J2000) = -58d 32' 59.0"

with an uncertainty of 1.8 arcsec (radius, 90% confidence).

The light curve (Fig. 2) can be modelled with a power-law decay with a decay index of  $\alpha=1.078_{-0.030}^{+0.031}$ .

A spectrum formed from the PC mode data can be fitted with an absorbed power-law with a photon spectral index of  $2.06_{-0.21}^{+0.22}$ . The best-fitting absorption column is  $1.6_{-0.5}^{+0.6} \times 10^{21} \text{cm}^{-2}$ , in excess of the Galactic value of  $2.5 \times 10^{20} \text{cm}^{-2}$  (Kalberla et al. 2005). The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is  $3.7 \times 10^{-11} (5.2 \times 10^{-11}) \text{ergcm}^{-2} \text{count}^{-1}$ .

A summary of the PC-mode spectrum is thus:

Total column:  $1.6_{-0.5}^{+0.6} \times 10^{21} \text{cm}^{-2}$

Galactic foreground:  $2.5 \times 10^{20} \text{cm}^{-2}$

Excess significance: 4.0 sigma

Photon index:  $2.06_{-0.21}^{+0.22}$

The results of the XRT-team automatic analysis are available at [http://www.swift.ac.uk/xrt\\_products/00525477](http://www.swift.ac.uk/xrt_products/00525477).

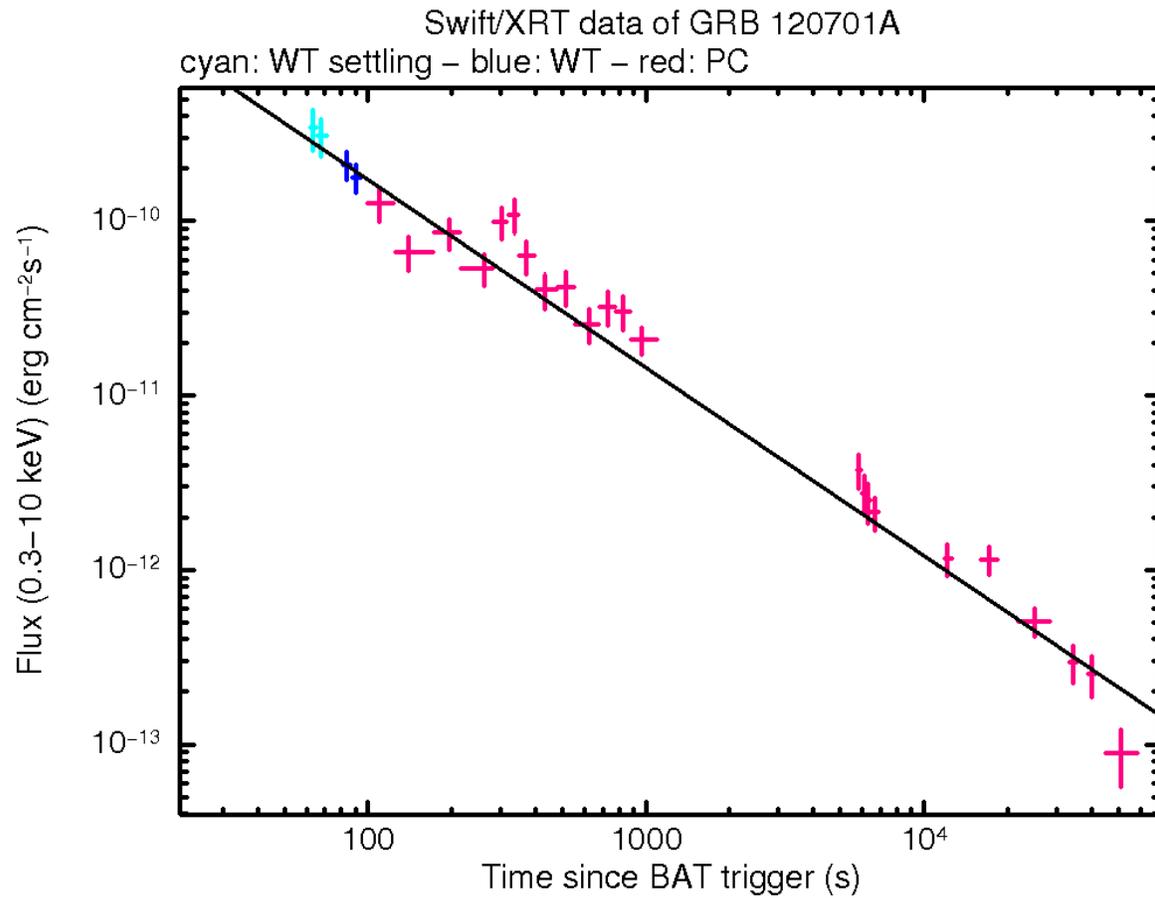


Figure 2: XRT Lightcurve. Flux in the 0.3–10 keV band is plotted with Window Timing (WT) mode data in blue, WT Settling data in light blue and Photon Counting (PC) mode data in red.

## 4 UVOT Observation and Analysis

The Swift/UVOT began settled observations of the field of GRB 120701A 89 s after the BAT trigger. A fading source consistent with the XRT and GROND (Elliott et al., 2012) positions is detected in the initial UVOT exposures in white and U.

Preliminary detections and 3-sigma upper limits using the UVOT photometric system (Breeveld et al., 2011) for the early exposures and summed exposures are:

Filter	Tstart (s)	Tstop (s)	Exposure (s)	Magnitude
white (FC)	89	239	147	$18.27 \pm 0.06$
white	880	1030	147	$20.01 \pm 0.36$
v	6603	6809	197	> 18.8
b	5994	18439	494	> 20.3
u_FC	303	553	245	$19.16 \pm 0.23$
u	5788	5988	197	> 19.9
w1	11812	12668	842	> 20.6
m2	6815	22538	969	> 20.7
w2	6405	6605	197	> 19.8

Table 1: Magnitudes and limits from UVOT observations

The magnitudes in the table are not corrected for the Galactic extinction due to the reddening of  $E(B-V) = 0.02$  in the direction of the burst (Schlegel et al., 1998).

## References

- Barthelmy, S. D., et al. 2012 *GCN Circ.* 13404
- Breeveld, A. A., & Ukwatta T. N. 2012 *GCN Circ.* 13410
- Breeveld, A. A., Landsman, W., Holland, S. T., et al. 2011, American Institute of Physics Conference Series, 1358, 373
- Elliott, J., et al. 2012 *GCN Circ.* 13409
- Evans, P. A., et al. 2012 *GCN Circ.* 13406
- Kalberla, P. M. W., et al. 2005, *A. & A.*, 440, 775
- Schlegel, D. J., Finkbeiner, D. P., & Davis, M. 1998, *ApJ.*, 500, 525